



NASA SBIR 2010 Phase I Solicitation

X3.03 Monitoring and Control for Spacecraft Environmental Quality and Fire Protection

Lead Center: JPL

Participating Center(s): ARC, GRC, JSC, KSC, MSFC

Monitoring and Control Technology Needs

Long duration human missions far from Earth and operation of closed loop life support systems have critical needs for monitoring and control for environmental quality and certifying recycled life support consumables. Monitoring technologies are employed to assure that the chemical and microbial content of the air and water environment of the astronaut crew habitat falls within acceptable limits, and that the life support system is functioning properly and efficiently. The sensors may also provide data to automated control systems. All proposed technologies should have a 3 year shelf-life, including any calibration materials (liquid or gas). The technologies will need to function in microgravity and low pressure environments (~8 psi), and may see unpressurized storage. Significant improvements are sought in miniaturization and operational reliability, as well as long life, in-line operation, self-calibration, reduction of expendables, low energy consumption, and minimal operator time/maintenance for monitoring and controlling the life-support processes.

- Process control sensors for closed loop life support systems: Targeted sensors include humidity in gases such as O₂, H₂, and CO₂; volatile organic compounds in O₂ and CO₂ (VOCs in CO₂ would be in the CO₂ removal/concentration product that would feed to any CO₂ reduction process); composition of CO₂ reduction effluent gases (CO₂, CO, CH₄, and H₂O) from either a Sabatier- or Bosch-based CO₂ reduction process; and combustible gas sensors for H₂ in an O₂ background and O₂ in an H₂ background from electrolysis.
- Trace toxic metals in water.
- Microbial monitoring of water and surfaces using minimal consumables.
- Optimal system control methods. Operate the life support system with optimal efficiency and reliability, using a carefully chosen suite of feedback and health monitors, and the associated control system.
- Sensor suites. Develop an approach for selecting number, types and placement of sensors in a distributed network for optimal environmental monitoring. Develop an approach to efficiently analyze data from a suite of sensors within a distributed network for optimal environmental monitoring.

Spacecraft Fire Protection Technology Needs

The overheating or combustion of spacecraft materials can introduce many types of particulate and gaseous contaminants into the cabin atmosphere. Technologies that not only detect smoke particulate but identify important characteristics such as particulate size and composition would be extremely useful for rapid identification of the fire

source. These must be of suitable size, mass, and volume for a distributed sensor array in spacecraft systems. Also, catalytic or sorbent technologies suitable for the rapid removal of gases, especially CO, and particulate during a contingency response are desired.